Lassonde School of Engineering
Department of Earth and Space Science and Engineering
Geomatics Engineering

LE/ESSE 4650 – Hydrography
Winter 2022

LAB # 3: Processing of Single Beam Echosounding Data (100)

Assigned: February 11, 2022
Due: March 4, 2022

Objective:
The objective of this lab is to acquaint students with CARIS HIPS and SIPS application software and the processing of single beam echosounder bathymetric data using the CARIS HIPS and SIPS application software.

Data and associated information:

You are provided with the following dataset:

- *Dual frequency single beam echosounder.*
- *Vessel: Single_Beam_Vessel_Bold*
- *Date Collected: 1 st August, 1998 (Julian Date 1998-213).*

And the following ancillary data:

- *Tide data = portblackney.cow*
- *SVP data = sv213a_b.svp*

IMPORTANT NOTE: The license for using the provided CARIS software and the provided datasets are only for the purpose of this lab assignment. Do not use or distribute any of the software, data or any related information outside this course.

SUBMISSION OF LAB TECHNICAL REPORT AND REQUIREMENTS:

1. Submit a full detailed report to demonstrate and explain your understanding of the steps involved in processing the echosounding data.
Include a workflow chart of the steps undertaken to process the echosounding data Additionally, you may utilize screenshots to show your results.

2. Throughout this document, there are several requirements for lab submission. These are highlighted in **red** under the heading '**DELIVERABLE #**'. Ensure these are requirements are also metand submitted along with your lab report.

3. The final mark is based on both the correctness of the answers and the overall quality of the report

Single beam processing workflow follows these major steps:

PREPARATION

- **Vessel File Creation**: Setup the sensor locations and uncertainties in the vessel reference frame.
- **Sensor and sensor selection**: Select sensors on the vessel
- **Create a HIPS file:** Setup the HIPS Data Source**.**

DATA LOADING AND PROJECT CREATION

- **Import data:** Raw data, sensor data
- **View data:** Open survey data
- **Save Project:** Save the current workspace (data and current view).

DATA PROCESSING

- **Sound velocity and tide corrections:** SVP Editor, Tide Editor
- **Georeferenced Bathymetry:** Combine vertical and horizontal information to produce geo-referenced data. Apply SVC and Tide correction**s**

OUTPUTS

- **Surface creation:** Processed Depths data is used to produce a bathymetric surface
- **Bathymetric products:** Soundings selection and Surface export.

Hydrographic Survey System / Data Information

Summary of sensor offsets for the equipment on vessel and dataset.

Sample Data Set

- Dual frequency single beam sonar.
- Vessel: Single_Beam_Vessel_Bold
- Date Collected: 1st August, 1998 (Julian Date 1998-213).
- Raw Data recorded in Hypack format

Sensor Offsets

- Transducer1: dX=0.0, dY= 0.0, dZ= 0.0, Roll= 0.0, Pitch= 0.00 and Yaw= 0.00
- Navigation: Time Error = 0.0, dX = 0.00, dY = 0.00 and dZ = 0.00, Ellipsoid=WG84
- Gyro: 0.00
- SVP 1: dX=0.0, dY= 0.0, dZ= 0.0, Roll= 0.0, Pitch= 0.00 and Yaw= 0.00

Positioning information

- Data in both Projected (UTM-12N) and geodetic coordinates.
- Referenced to WG84 ellipsoid.

Rawness of data

- Not corrected for vessel motion (No sensor data).
- Travel time and distance are computed from single beam values

Relevant Ancillary Data

- Tide data = portblackney.cow
- SVP data = sv213a_b.svp

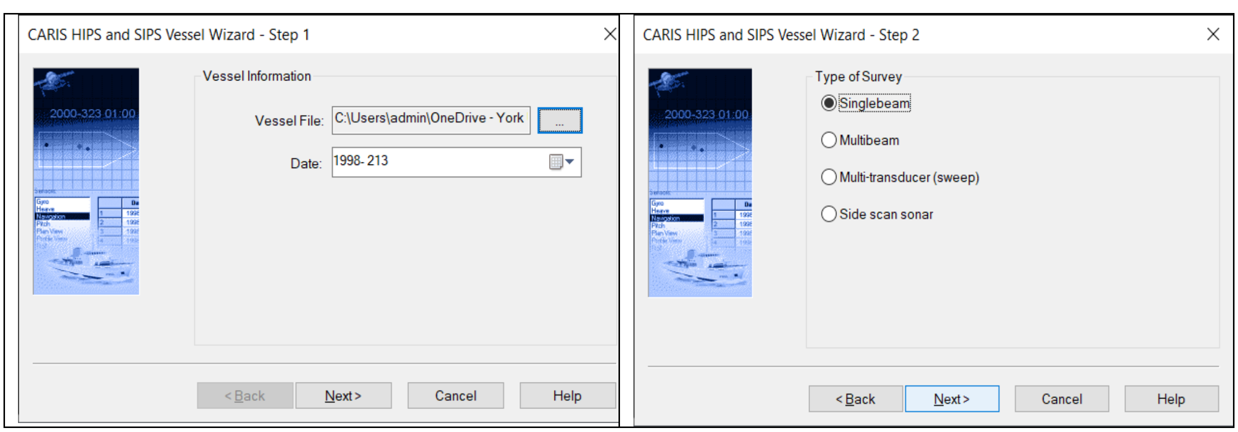
0. Task 0: Familiarization with CARIS software and the loading of the bathymetric data

Software demonstration.

1. Task 1: Vessel Creation

We will start by launching the Vessel Wizard from the Vessel Editor to begin the initial set-up of the vessel file. The Vessel Wizard takes the user through a step-by-step process to configure a vessel file from scratch. This vessel file can then be edited further in Vessel Editor.

a. Click **Vessel Editor** icon, or select **Tools > Editors > Vessel…** option from the main menu.
Or
b. Click the **New** icon or select **File > New** option from the Vessel Editor menu.
c. On **Vessel File** click the browse (…) and navigate to the folder **…\Training\HDCS_Data\VesselConfig** and name the vessel **mySBVessel,** click **Next**.

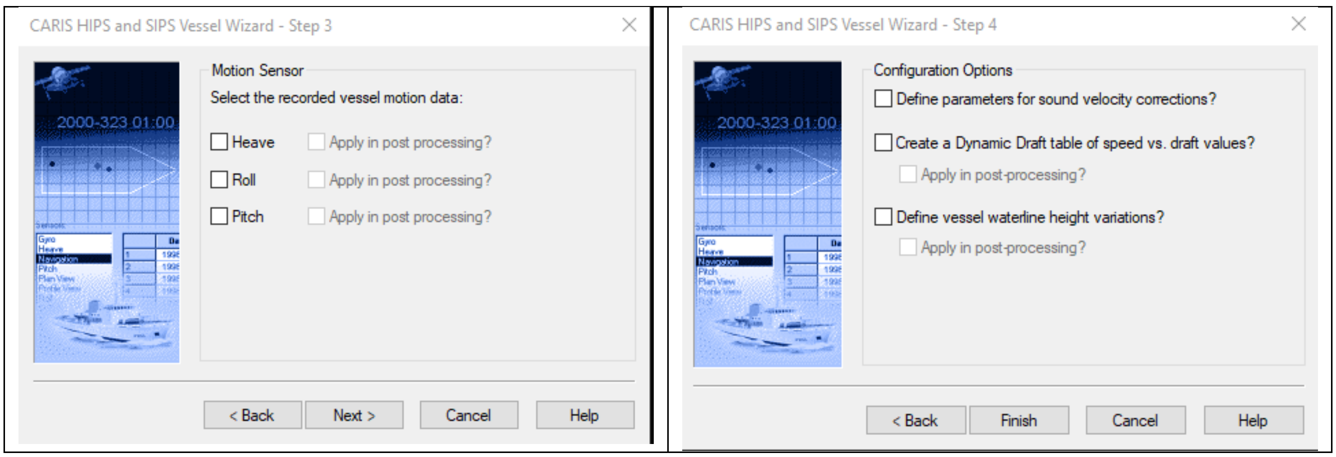


d. On **Date** and type **1998** for the year and **213** for the day. You can click the Calendar button
on the right side and double-click **August 1, 1998** as well**.** Use the arrows to change the month.
Click **Next**.

e. Select the **Singlebeam** radio button for the Type of Survey and click **Next.**

f. Leave all **Motion Sensor** disabled in Step 3.

g. In Step 4: leave all options disabled and click **Finish**



Editing the Vessel shape

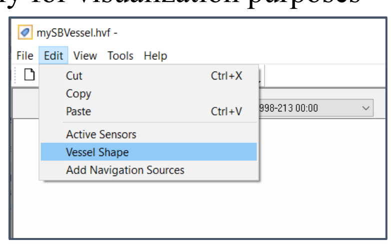
The Vessel Shape collects information to generate graphic views of the ship. All dimensions are in meters.

Advantages of the vessel shape diagram:

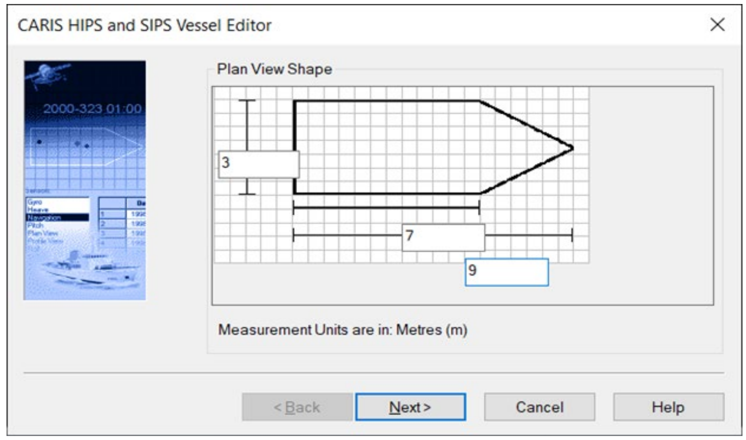
- Allows visual location of the Reference Point (RP).
- Allows visual location of all the sensors with relation to the RP.
- Allows immediate visual verification that offsets have been applied correctly.

Note: The vessel shape **does not** affect processed data. It is merely for visualization purposes in the HIPS Vessel Editor.

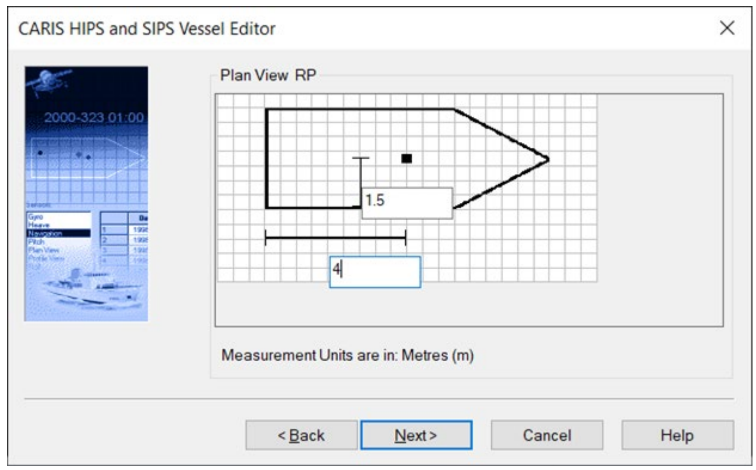
A vessel can be defined or modified by selecting **Edit > Vessel Shape** from the main menu or by selecting the **Vessel Shape** Button from the main toolbar.



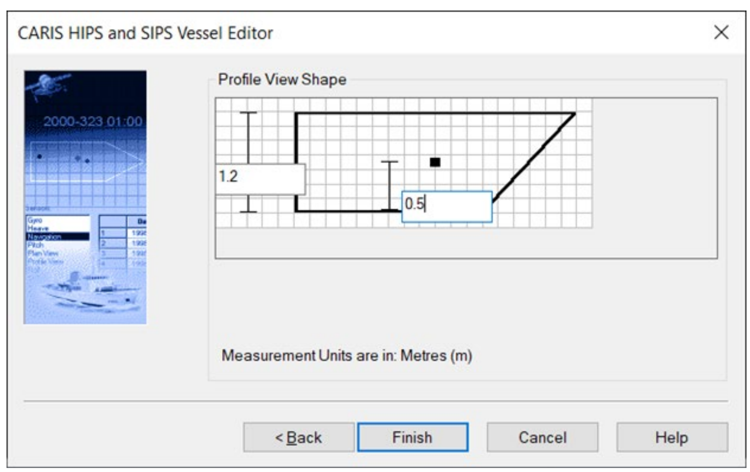
1) Enter Plan View Shape dimensions, **total length 9.0 m, main length 7.0m** and **beam3.0 m,** and then click **Next.**



2) Enter Plan View RP position 1.5 m from starboard side, 4.0m from stern. Click Next.



3) Enter Profile View Shape dimensions, Keel to RP 0.5 m, Keel to Deck 1.2 m. Click Finish



DELIVERABLE 1 (8):

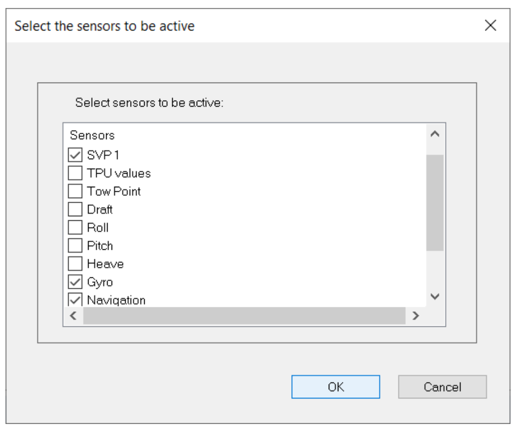
Verify that the vessel file has been created and stored. Generate the graphic to visualize your vessel showing the location of the Reference Point (RP), the location of all sensors relative to

RP and verification of the correct application of the offsets. Comment on the alignment of the sensors with respect to the vessel's axes.

2. Task2: Sensors and Sensors Selection

Active sensors of the current vessel configuration file are listed in the lower left window of Vessel Editor. Sensors can be added to or removed from the display. Only active sensors can be configured for installation offsets, biases and errors.
The table display shows the configuration parameters of the sensor.
• Several entries can be made with a time stamp index: date and time.
• A time stamp is required for each table entry.

In this task, you will add SVP 1.
a. Click the **Active Sensor** icon or select **Edit > Active Sensors** from the Vessel Editor menu.



b. Enable the **SVP 1** check box and click OK.

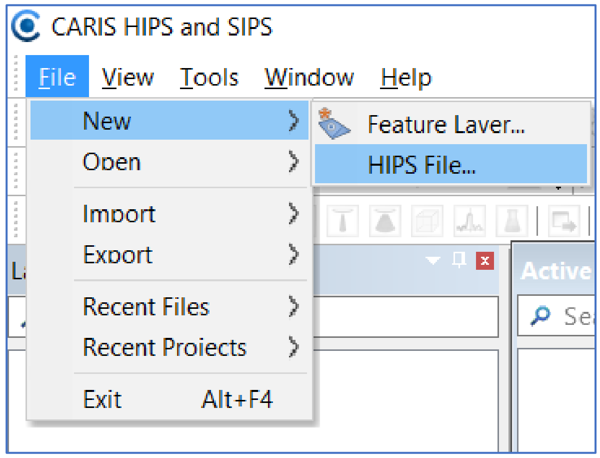
This will add SVP1 to the list.

c. Select SVP 1 as additional sensor to be active if not already configured and click OK.
d. Click the Save icon and select **File > Exit** to close the Vessel Editor.

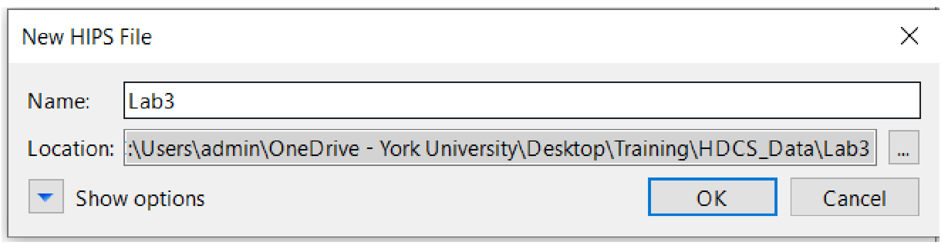
DELIVERABLE 2 (6):
In addition to SVP1, add navigation, transducer, gyro, and draft as your vessel's sensors. Provide the colour table showing the available sensors and their colours used for the display of the Vessel Shape.

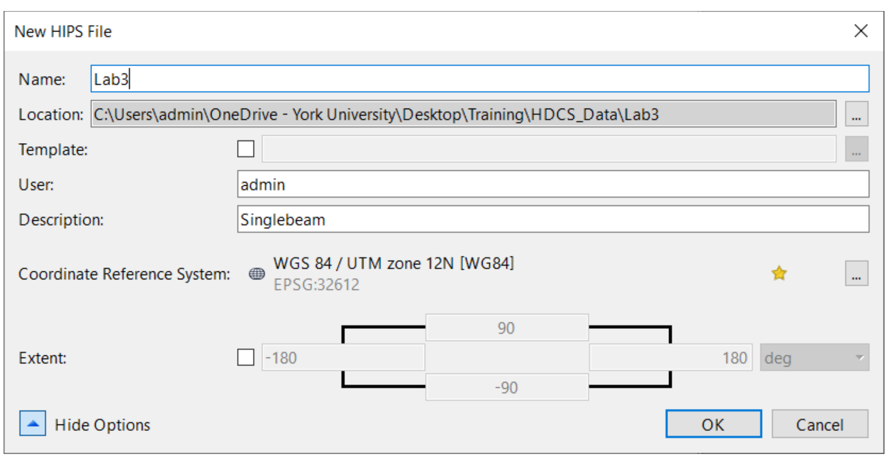
3. Task 3: Create the HIPS Project file

1. Chose File >> New >> HIPs File



2. On **Location** browse to Desktop\Training\HDCS_Data\



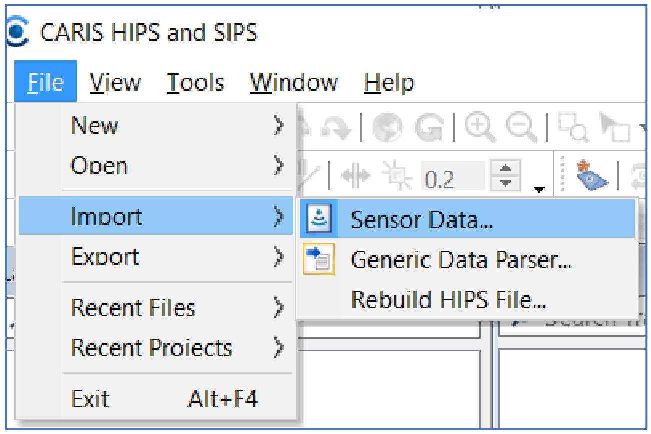


3. On Description, type **Single Beam** and chose the **Co-ordinate Reference System WGS 84 UTM zone 12N**
4. Then Click OK.

DELIVERABLE 3 (10):
Provide the output window showing the creation of the HIPS file (start and end date and time).

4. Task 4: Import Sensor Data

Step 1: Click the Import Sensor Data icon or select File > Import > Sensor Data from the menu.

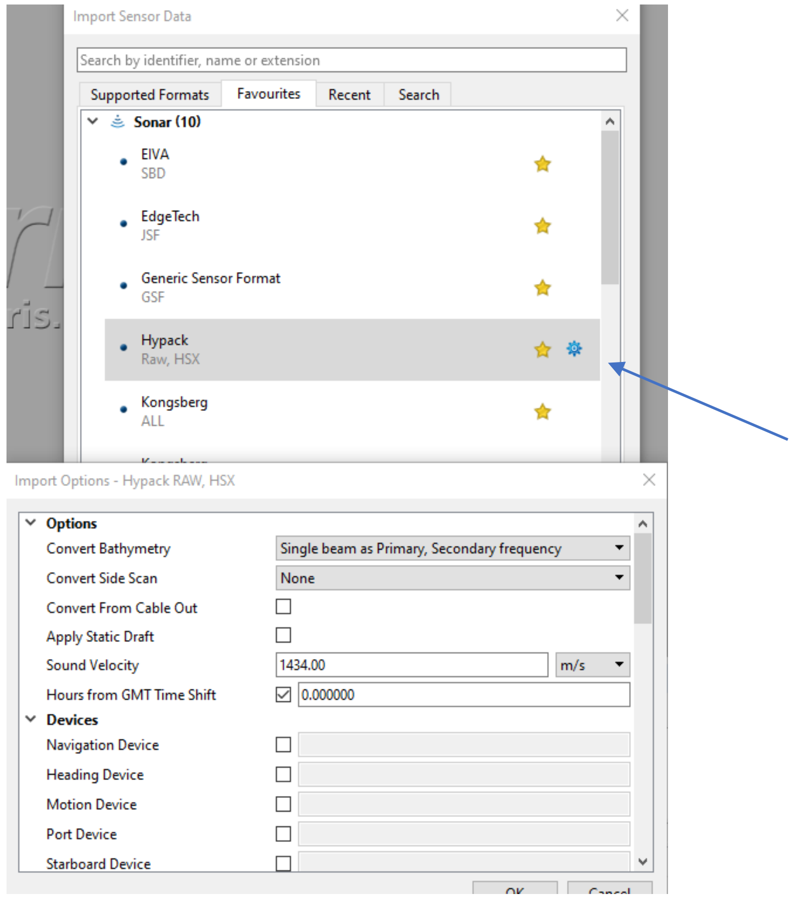


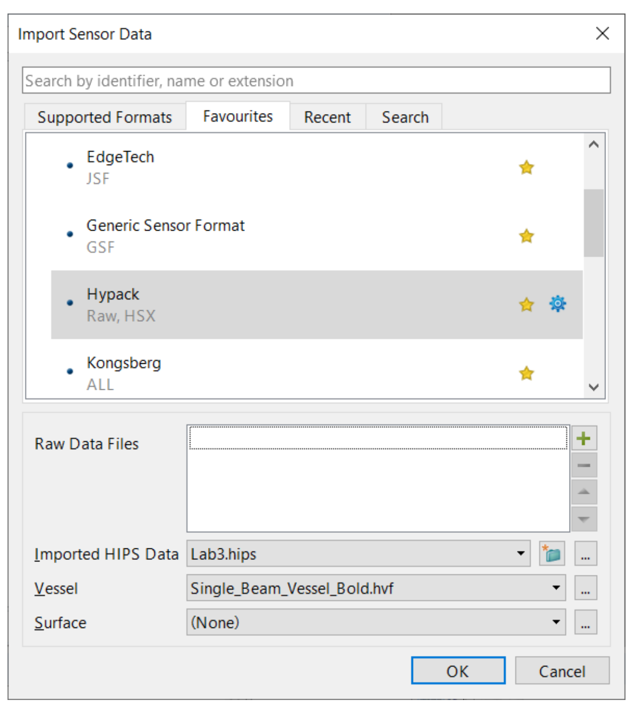
Step 2: In Formats, click **Hypack RAW, HSX** from the list of formats.

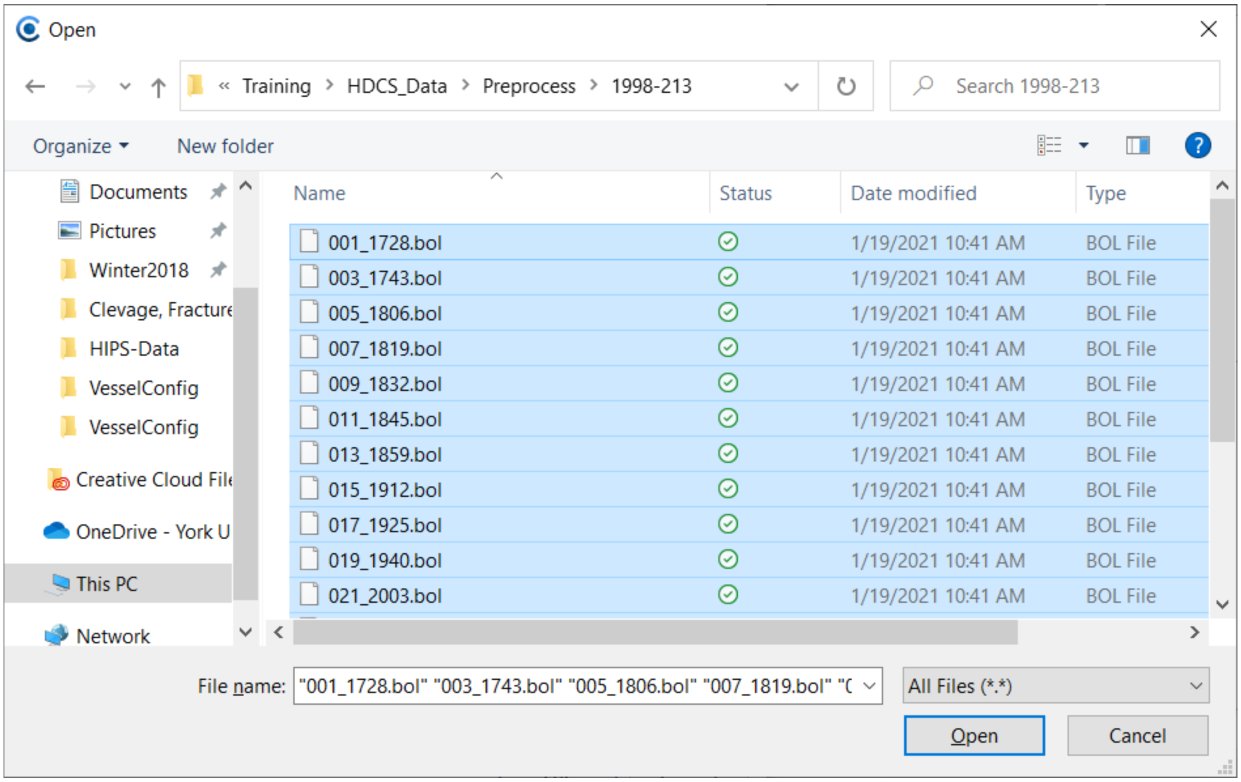
Click the blue cog to access the import options dialog window**.**

Select **Single beam as Primary, Secondary frequency** from the Convert Bathymetry dropdown menu.

Change the **sound velocity to 1434.00 m/s.** Leave all additional properties to default, click ok.


Import Sensor Data
Search by identifier, name or extension
Supported Formats
Favourites
Recent
Search
Sonar (10)
EIVA
SBD
EdgeTech
JSF
Generic Sensor Format
GSF
Hypack
Raw, HSX
Kongsberg
ALL
Import Options - Hypack RAW, HSX
Options
Convert Bathymetry
Single beam as Primary, Secondary frequency
Convert Side Scan
None
Convert From Cable Out
Apply Static Draft
Sound Velocity
1434.00
m/s
Hours from GMT Time Shift
0.000000
Devices
Navigation Device
Heading Device
Motion Device
Port Device
Starboard Device

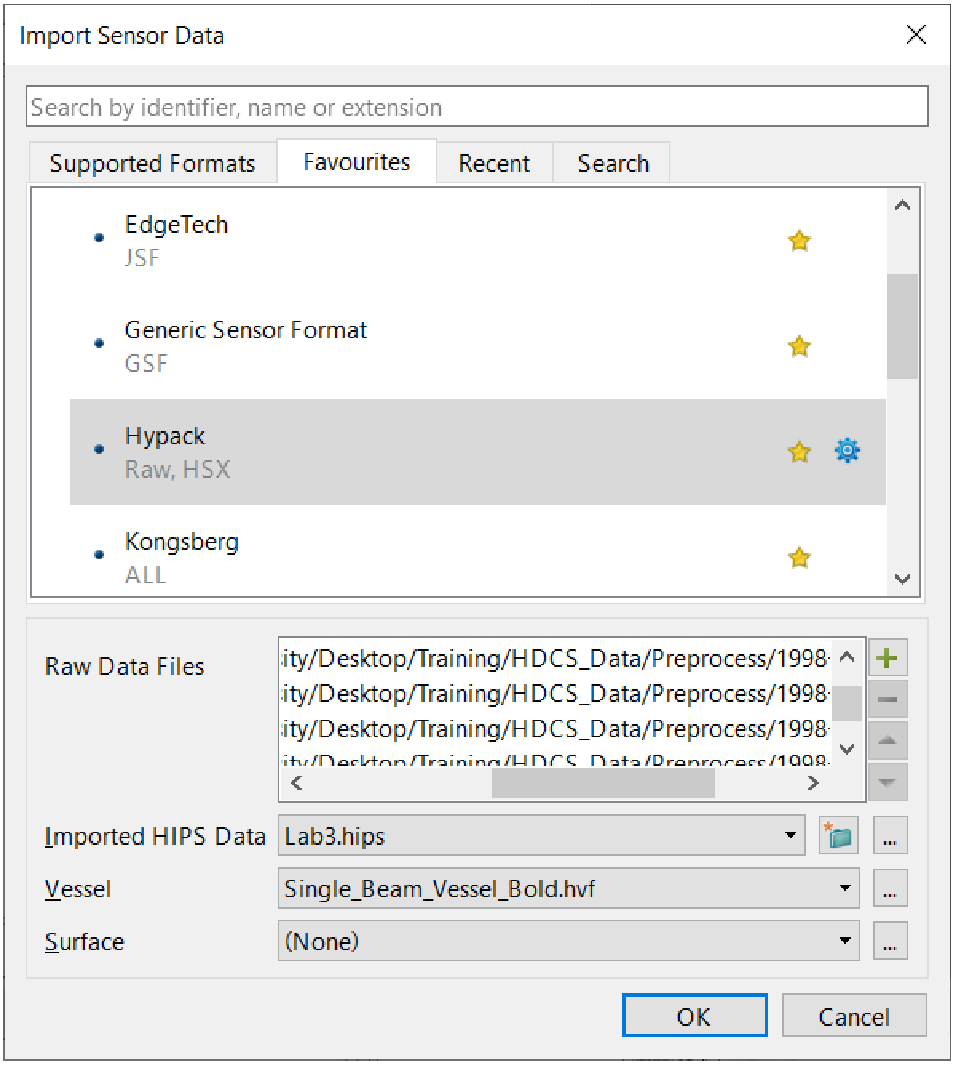

Import Sensor Data
Search by identifier, name or extension
Supported Formats
Favourites
Recent
Search
EdgeTech
JSF
Generic Sensor Format
GSF
Hypack
Raw, HSX
Kongsberg
ALL
Raw Data Files
Imported HIPS Data
Lab3.hips
Vessel
Single_Beam_Vessel_Bold.hvf
Surface
(None)
OK
Cancel

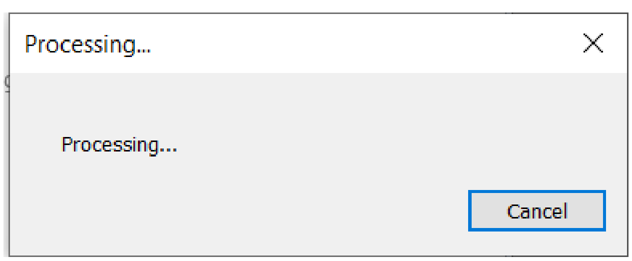


Step 4: To access the data files:

Open **C:\..>** preprocess> 1988-213>(change file format to All files to see .bol files)>

Select all the files and import. After selecting the right HIPs data and vessel, Click OK.



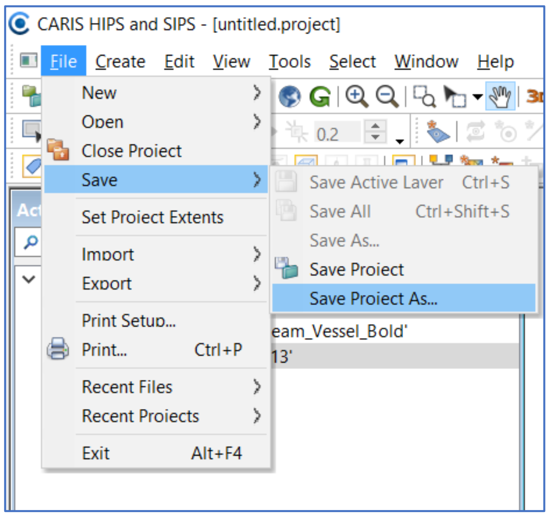


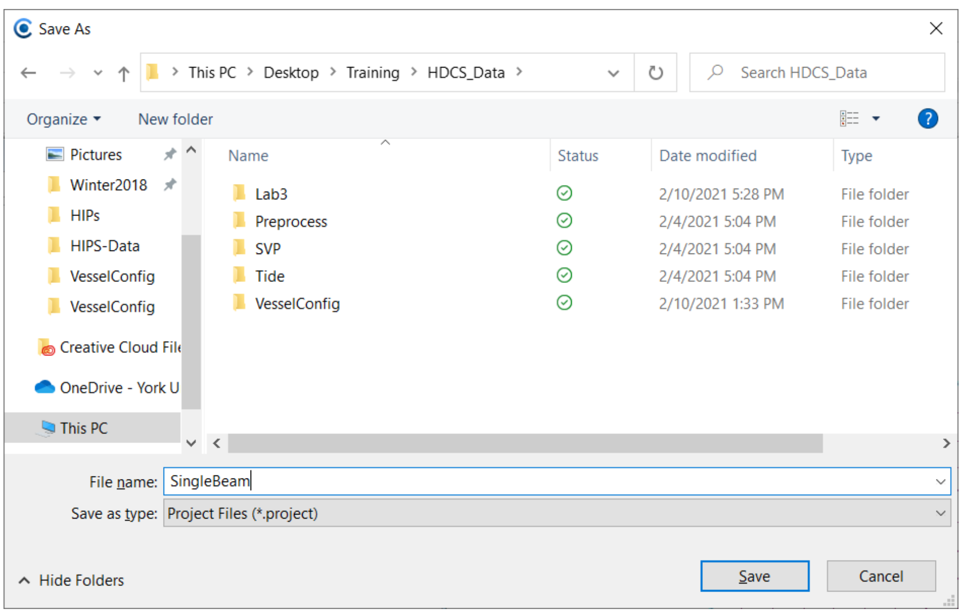
DELIVERABLE 4 (7):
How many survey lines have been successfully read in?

DELIVERABLE 5 (8):
Show that the HIPS file has been created and opened in the main HIPS and SIPS interface. Provide screen caption.

DELIVERABLE 6 (5):
Report on the extent to geographical coverage of the area in UTM coordinates. What is the area of the coverage in square km?

5. Task 5: Save Project





6. Task 6: Processing Workflow

The data has been imported into the HIPS format and indexed, therefore we can now utilize the Georeference Bathymetry tool to complete the necessary processes prior to seabed surface generation.

Task 6.1 Use SVP Editor to create sound velocity profiles

SVP Editor is used to create and edit sound velocity profiles that will be used in the sound velocity correction process. Follow the steps in Single Beam Manual Pages 41-42 (Exercise 12 of the manual).

DELIVERABLE 7 (7):
Sound velocity profile screen caption.

DELIVERABLE 8 (7):
Provide the sound speed at the following depths for the two profiles (11:46:00 and 12:00:00) at 0.50m, 5.20m, 6.70m

Task 6.2: Examine the Tide editor.

Follow the steps in the Manual Page 43(Exercise 13 of the manual).

DELIVERABLE 9 (6):
Tide editor screen caption.

DELIVERABLE 10 (7):
Provide Date, Time, of the minimum and maximum Tide (in meters).

7. Task 7: Georeference Process - Vertical and Horizontal components

Once the Georeference Bathymetry process has performed the Sound Velocity Correction and the Tide has been loaded, the final sounding depth and geographical position must be calculated. The Georeference process will combine tide observations, observed depths, sensor data and HVF offsets to produce geo-referenced soundings.

Follow the steps in the Manual Pages 44 -52 and make sure that all track lines are georeferenced to combine all tide observations, observed depths, sensor data and HVF offsets to produce geo-reference soundings. (Exercises 14- 15 of the manual).

Vertical offset, use of Realtime Heave. All other parameters default
For Sound Velocity Correction select Nearest in Time
For Vertical Datum reference select Tide

Horizontal component (keep default, use gyro values equal to zero as per default)

DELIVERABLE 11 (8):
Show that the SVP and Tide corrections has been applied to all survey lines. After applying the SVP correction, which surface do the depths refer to? After applying the Tide correction, which surface do the depths are relative to?

8. Task 8 - Surface Creation - Create a regular Gridded Surface

A gridded surface can only be created after the soundings are georeferenced (Georeference Bathymetry Process). The CARIS surface is a gridded representation of the georeferenced sounding data, created using various gridding algorithms.

Follow the steps in the Manual Pages 57-59 (Exercises 16 of the manual).
Since there are no Uncertainties (TPU) calculated for the soundings, we are limited in this exercise, to algorithms Swath Angle and Shoalest Depth True Position

DELIVERABLE 12 (6):
Generate a regular gridded surface

9. Task 9: Bathymetric Products

Bathymetric products could be generated from the Swath Angle surface created in the previous exercise, or other layers that can be created from the data to be used for further analysis

Task 9.1: Sounding selection

It is impossible to display all soundings produced by a multibeam survey on a map or chart and maintain legibility. The selection of soundings that appear should be dependent on chart scale and purpose. Follow the steps in the Manual Pages 61- 64. (Exercise 17 of the manual).

DELIVERABLE 13 (7):
Generate a plot of the selected soundings

Task 9.2: Export Data - Generate a surface

Data can be exported from HIPS and SIPS to a variety of formats. It is possible to export vector products (i.e. contours and soundings), HIPS data, surfaces, the Display View, Contacts, and Mosaics. HIPS data (soundings) can be exported to ASCII and other formats. Additionally, bathymetry from surfaces can be exported to images, other gridded data formats (such as point cloud or BAG), and to ASCII. The surface generated in HIPS and SIPS can be exported to ASCII or several Raster formats, like point cloud (Csar), GeoTIFF and BAG.

Follow the steps in the Manual Page 70. (Exercises 19 of the manual) to generate the seabed surface in GeoTIFF format.

DELIVERABLE 14 (8):

Determine:
a) the average length of the surveys lines,
b) the average separation distance of the survey lines,
c) the planimetric coordinates and the depth of the first and last points on the line corresponding to your group number (count lines from the upper left corner of the coverage area).
Note: you have to import the GeoTIFF file to a GIS-type system, such as PCI Geomatica, ArcGIS or Q-GIS.